

“A Comparative Evaluation of the surface roughness of two glazed, unglazed and polished ceramic materials.”

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Abstract:

Background: Dental Ceramics have played a pivotal role in dentistry over the past 150 years because of their excellent biocompatibility, light absorption and low thermal conductivity .In spite of their advantages and advances in material over the last few years, Ceramic still have drawbacks like poor marginal fit, low tensile strength, difficulty in polishing and excessive wear of opposing teeth.

Material & Methods: Glazed porcelain is the restorative material that encourages least plaque accumulation and also allows for plaque to be easily removed. Glazed porcelain can also duplicate natural tooth surface lustre, characterization while it is generally agreed that glazed ceramic provides the optimum surface finish.

Observations & Results: After applying Student's 't' test, there was seen a highly significant difference between mean values of Unglazed and Polished ceramic materials in In-Cream and IPS Empress group (i.e. $p < 0.01$). while there was found no significant difference between mean values of Glazed ceramic material in In-Cream and IPS Empress Group (i.e. $p > 0.05$)

Conclusion: From the present study, we may conclude that, Regardless of the type of ceramic tested (IPS Empress or In-Ceram Alumina/ Vitadur Alpha) or pretreatment, any adjusted ceramic restoration should be reglazed or subjected to a finishing sequence that is followed through to a final stage of polishing with diamond paste and Unglazed IPS Empress 2 is rougher than unglazed In-Ceram Alumina/Vitadur Alpha.

Key words: glazing, unglazing, finishing, IPS Empress 2, surface roughness.

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Introduction: With the increasing clinical success and esthetical pleasing appearance of All Ceramic materials, the use of PFM restorations is declining, and is being replaced by the use of All ceramic restorations. The surface finish of ceramic restorations is important with respect to esthetics strength, wear of opposing teeth. Hence, glazing has always been advocated

as the last surface treatment before final cementation.

Currently there exists a considerable controversy over applying the best method to achieve the smoothest and strongest porcelain restoration. The present study was undertaken to investigate the average surface roughness (Ra) of two ceramics (IPS Empress 2 layering glass ceramic and in Ceram) either glazed, Unglazed or polished.

Materials and Methods:

1. A circular custom made metal template with dimensions 8.5 cm in diameter and 8mm in height containing equal space of 6mm by 2mm for making sample or ceramic wax patterns.
2. Agar duplicating machine /flask (Gelovit MP- Bego, Gerate-nr-278125, Bego-wilhem-herbsr-str. D-28359, Bermen Germany)
3. Investing material (IPS Empress speed, West)
4. In-Ceram powder and liquid.
5. Vita furnace (Vaaccumat 50 nr-5137, vita zahnfabrik router GmbH & co KG, D-79713 Bad Sackingen)
6. Vita sonic unit (In-Ceram vita sonic II ultrasonic unit)
7. IPS Empress furnace (SR IVOCOLAR VIVADENT , FL-9494 Schaan, Liechtenstein, Made in Austria)

Whipmix Vaccum mixer (Continental Vaccum power mixer , Whipmix Made in USA) Model no -5KH39QN9231X

9. Layering and Glazing material (Vita VM7 Basic Kit, fine structure ceramic for veneering Vita in Ceram Alumina substructure)
10. Porcelain Adjustment kit (N 0301, shofu)
11. Gelloni surveyor
12. Profilometer (HOMMEL WERKE- TURBO WAVE V7.20).
13. IPS Empress Ingots.

Methods:

Method for fabrication of In-Ceram samples :

a) Method for fabrication of In-Ceram core:

The custom made metal template was duplicated using agar. Material was poured in the investment mold to half fill the molds. It was then fired according to manufactures instructions in vita vacuumat 50 ceramic furnace.

b) Layering of In Ceram samples:

A Layer of dentin and a layer of enamel was coated with the help of custom made Instrument consisting of a loop of orthodontic band of desired shape and dimension. The firing was carried out.

The samples recovered after the respective dentine and enamel firing were further finished prior to glazing. All samples were then glazed using the mentioned programmed in the vita

vacumat 50 ceramic furnace.

All the 30 glazed samples were grounded with contouring dura white stone, These 30 samples were further divided into 3 groups of 10 each.

Method of fabrication of IPS Empress samples:

a) Method for fabrication of IPS-Empress core

Wax was poured in the custom fabricated metal mold to obtain a wax pattern for 30 IPS empess samples.

b) Layering of IPS- Empress samples :

A Layer of dentin and a layer of enamel was coated with the help of custom made Instrument consisting of a loop of orthodontic band of desired shape and dimension. The firing was carried out.

Observations:

Table No. 1: Distribution of mean and SD values of surface roughness of In-Cream and IPS-Empress Groups:

	In -Cream (n=10)	IPS-Empress (n=10)
	Mean ± SD	Mean ± SD
Unglazed	1.2142 ± 0.3437 (0.721 – 1.749)	0.5911 ± 0.1468 (0.418 – 0.979)
Glazed	0.3750 ± 0.1927 (0.105 – 0.787)	0.3002 ± 0.1164 (0.086 – 0.474)
Polished	0.5093 ± 0.1695 (0.256 – 0.783)	0.3336 ± 0.0958 (0.204 – 0.496)

The samples recovered after the respective dentine and enamel firing was further finished prior to glazing. The entire surface must be ground evenly and grinding dust must be thoroughly removed. Recommended glaze firing carried out. Thus the obtained 30 samples were grounded with dura contouring white stone. These 30 samples were further divided into 3 groups of 10 each.

III Checking for surface roughness of samples:

Comparison of various readings of surface roughness obtained from the Profilometer. These comparison were done as follows to achieve the various objectives of the study. These reading were noted and were subjected to statistical analysis. The mean and standard deviation of the surface roughness (Ra) were calculated and results subjected to student ‘t’ test.

Table No. 2: Distribution of mean and SD values of surface roughness of In-Cream and IPS-Empress Groups:

	In -Cream (n=10)	IPS-Empress (n=10)
	Mean ± SD	Mean ± SD
Unglazed	1.2142 ± 0.3437 (0.721 – 1.749)	0.5911 ± 0.1468 (0.418 – 0.979)
Glazed	0.3750 ± 0.1927 (0.105 – 0.787)	0.3002 ± 0.1164 (0.086 – 0.474)
Polished	0.5093 ± 0.1695 (0.256 – 0.783)	0.3336 ± 0.0958 (0.204 – 0.496)

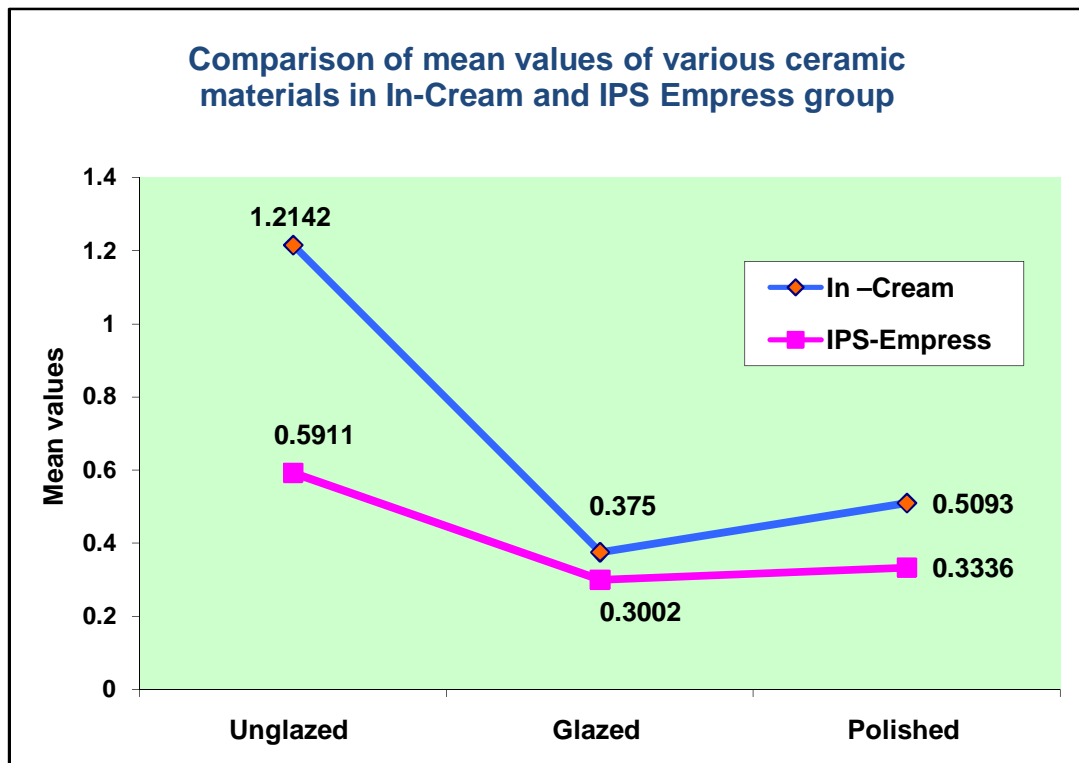


Table No. 3: Comparison of mean values of surface roughness of various ceramic materials in In-Cream and IPS Empress Group:

Ceramic materials	In-Cream (n=10)	IPS Empress (n=10)	't' value	'p' value	Result
	Mean ± SD	Mean ± SD			
Un-glazed	1.2142 ± 0.3437	0.5911 ± 0.1468	5.28	p<0.01	Highly significant
Glazed	0.3750 ± 0.1927	0.3002 ± 0.1164	1.08	p>0.05	Not significant
Polished	0.5093 ± 0.1695	0.3336 ± 0.0958	2.88	p<0.01	Highly significant

Results: After applying Student's 't' test, it was seen that there was a highly significant difference between mean values of Unglazed and Polished ceramic materials in In-Cream and IPS Empress group (i.e. p<0.01) while there was found no significant difference between mean values of Glazed ceramic material in In-Cream and IPS Empress Group (i.e. p>0.05)

Discussion: The aim of glazing is to seal the open pores in the surface of fired porcelain. Dental glazes are composed of colourless glass powder, applied to the fired crown surface, so as to produce a glossy surface.¹

The adjustment of a porcelain restoration, for occlusal or contour correction, may have an unfavourable secondary impact on the neighbouring teeth, depending on the location of the adjustment. The adjusted rough surface may lead to abrasive wear of the opposing dentition or increase the rate of plaque accumulation.^{2,3} Unglazed or trimmed porcelain may also lead to

inflammation of the soft tissues it contacts.⁴ Trimming of porcelain may cause some reduction in the strength of a ceramic restoration.^{5,6}

Occlusal contacts between unglazed porcelain and opposing unglazed porcelain or enamel are undesirable because of the high rate of wear of enamel and porcelain.⁷ Early researchers agreed that re-glazing was necessary after porcelain adjustment in the clinical setting.⁸ Many dentists therefore, prefer the porcelain surface of a restoration to be glazed (or re-glazed) prior to cementation.⁹

In this study the various samples of IPS Empress and In-Ceram were compared to rule out the surface roughness of different porcelain systems. Further the comparison was done with glazed, Unglazed and polished samples between both the groups and then the comparison was done within the same group of samples.

All the obtained 60 samples were fabricated according to the manufacturer's instruction (30-IPS empress and 30- In Ceram). These samples were further divided into glazed, unglazed and polished group containing a sample size of 10 each.

The surface roughness was noted according to the standardized Profilometer device. The reading obtained by the various samples (glazed, unglazed and polished) of both the system (IPS empress and In Ceram) were noted and then the comparison was done between the various samples of both the systems of ceramic (intergroup) and then within the same system of ceramic (intragroup).

The results obtained were subjected to statistical analysis and mean and the standard deviation was calculated were calculated and then subjected to students 't' test.

As it is known that In-Ceram /vitadur alpha is composed of glass powder and fused alumina crystals that constitute upto 50% by weight such a granular, porous and weak structure would cause greater roughness. It was observed that IPS Empress samples were smoother compared to the In-Ceram samples in all the respective groups, ie:

- Glazed samples of IPS empress were smoother compared to the Glazed samples of In ceram, which is not that statistically significant.

- Unglazed samples of IPS empress were smoother compared to the unglazed samples of In-Ceram, which was statistically significant.
- Polished samples of IPS empress were smoother compared to the polished samples of In-Ceram, which was statistically significant.

It was found that the Glazed samples of IPS empress were smoother than the unglazed and polished samples of IPS empress which was highly statistically significant. Further the polished samples were found to be smoother than the unglazed samples of IPS empress which was highly significant.

Conclusion:

From the present study, we may conclude that, Regardless of the type of ceramic tested (IPS Empress or In-Ceram Alumina/ Vitadur Alpha) or pretreatment, any adjusted ceramic restoration should be reglazed or subjected to a finishing sequence that is followed through to a final stage of polishing with diamond paste and Unglazed IPS Empress 2 is rougher than unglazed In-Ceram Alumina/Vitadur Alpha.

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Legends:

Figure 1: Layered In ceram samples before firing

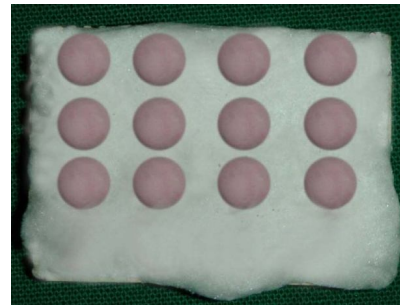


Figure 2: Ceramic samples on a mould base being polished on a surveyor



Figure 3: Profilometer with software version V 720



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